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TELEGRAPHIC FIRE ALARMS FOR LONDON.

THE importance of telegraphy as a swift means of conveying warnings is every day receiving more and more attention. In France it has been recently applied to notify the approach of floods on canals, in Norway to acquaint the fishermen of the fiords with the whereabouts of the herring schools, in America it is doing valuable daily service as a foreteller of storms or weather changes, and in more countries than one it is being adopted in the great towns as an alarm in cases of fire. The advantages of a system of telegraphic fire alarms in a great city must be apparent to any one who bestows the least thought on the subject. In a town unprovided with such a system, the only mode of calling the fire-brigade is to run or drive to the nearest fire-brigade station. When the paralysing alarm and excitement of tenants in a burning house, their possible ignorance of the true position of the station, the proverbial delinquency of the public guardian, and the actual distance of the site of the fire from the station in question are taken into account, it will be seen that the ordinary plan of procuring help is at best a clumsy, slow, and imperfect one. With a proper system of fire-alarms, much agitation, blundering, and precious time may be saved. All the principal thoroughfares would be provided with street alarm posts, which would be as conspicuous and become as well-known as the street letter boxes. They would be situated at short and regular distances, say two hundred yards from each other, and would be accessible to the public by some simple means, such as the breaking of a protecting pane of glass. The mere pulling of a handle or pressing of a knob would then in an instant alarm the nearest brigade station, and indicate the position of the fire. In a few moments more some simple acknowledgment of his signal would be returned to him. If the fire were serious and urgent, he could let the fact be known by a further simple signal. All this could be done by the most ignorant person, and even by a child; but it would of course be most frequently the work of the district watchman. An ordinary telegraphic recording instrument could in addition be provided in the event of special communication being desirable between the fire-men and the station.

We all know that the growth of a fire proceeds in an accumulating ratio which far outstrips the compound interest law. A spark may kindle a great conflagration, but not all at once. In its early stages an outbreak of fire, though alarming, is weak, and may be readily extinguished; but it gathers strength and appetite by what it feeds on. At its beginning it is most vulnerable, but it is precisely this invaluable period which is frittered away and lost by the existing dilatory mode of alarm. While the messenger is hurrying on foot through, it may be, long and crowded thoroughfares to the Brigade Station, the fire is making good its hold, not only consuming more property, but rendering it a far more difficult, dangerous, and expensive task to get it out. Any saving of time during this incipient period is supremely important, and it is this saving which telegraphic alarms permit of. Their introduction would not only diminish the risk of life attending the fireman's work, the ravages of the fire, and the expense of extinguishing it, but they would be a convenience and a source of increased safety and security to the public.

The American's were quick to perceive the solid benefits of fire alarm systems, and many of their cities are provided with them. On the Continent recently, and in Glasgow, a like precaution has been adopted. Why then, we are tempted to ask, is London without such a system—London, in which, owing to its crowded streets and its masses of buildings, fire operations are difficult, and where the distance is sometimes as great as two miles between the nearest Brigade Station and the seat of the fire? Our London Fire Brigade is the admiration of all who have seen it at work, but in spite of its prompt and vigorous action, it is often taken at a disadvantage, and the daily papers are witness to the great loss of property, if not of life, which is caused by London fires.

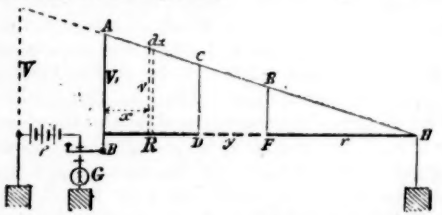
Is it due to an indiscriminating conservatism or to a stolid inertia, that the authorities have not taken steps to introduce fire-alarms? The advantages are so apparent that they must recommend themselves to all unbiassed persons; and if examples are wanted, we could not have a better variety than New York, Amsterdam, Paris, and Glasgow. It may, in fact, be taken for granted that our canny friends beyond the Tweed would not adopt any new-fangled concern rashly. The Scotch, however, have the shrewdness to examine and see for themselves, and the enterprising liberalism to promptly adopt a good thing when they find it. It is to be hoped that their example will quicken the Metropolitan Board of Works to bestir themselves in earnest about this matter. It is inevitable that a telegraphic system of fire-alarms for London must come sooner or later, and the authorities will earn our thanks if they hasten it as much as possible.

Public opinion will otherwise have to fall back on the far less satisfactory plan of forcing such a course upon them. We do not propose to deal here with the relative merits of different systems. Any system is better than none; but, after due investigation, let the best be chosen.

LOCALISATION OF A PARTIAL DISCONNECTION IN A SUBMARINE CABLE.

PARTIAL disconnection faults, although they are seldom met with in cables with gutta-percha cores, frequently occur in those whose insulating material is india-rubber. This arises from the elasticity of the substance; for when any undue strain is put on the core the conductor breaks, but the india-rubber only stretches, and an earth fault is not made. When the strain is taken off, the two ends of the conductor come together and make contact more or less perfectly. If the break is noticed at the moment the cable is being laid from the ship, its position is of course known. But in some cases a fault of this nature does not develop itself until some time after the submersion; its locality can then only be found by testing.

Such faults are difficult to localise, as none of the ordinary tests are applicable to them. The following method, however, is susceptible of considerable accuracy if carefully made.



In the fig. let R, r be the resistances of the portions of cable on either side of the fault, y being the resistance of the latter. Let ρ be the resistance of a battery normally connected to the cable by a discharge key, and let G be the resistance of a galvanometer, through which the cable can be discharged on the depression of the key.

Now, if the further end of the cable be to earth, and V be the potential of the battery when its poles are free, then V_1 will be the potential at the end B of the cable, and v will be the potential at a point distant x from B. And further, A B D C will represent the charge in the portion R of the cable, and B F G the charge in the portion r.

Now if the key is *instantaneously* depressed so as to put the cable in connection with the galvanometer, the charges in the cable will flow out at both ends.

Let $v.dx$ be a differential part of the charge A B D C, then this portion will split, and the portions flowing out at the two ends of the cable will be inversely proportional to the resistances on either side of it; thus the portion flowing out through G will be:

$$d\,Q' = v\,\frac{R + y + r - x}{G + R + y + r}\,dx.$$

Now

$$V_1 : v :: R + y + r : R + y + r - x,$$

therefore

$$v = V_1\,\frac{R + y + r - x}{R + y + r}$$

that is

$$d\,Q' = V_1\,\frac{(R + y + r - x)^2}{(G + R + y + r)\,(R + y + r)},$$

and the integral of this between the limits

$$x = R \text{ and } x = 0$$

will give the quantity Q′ flowing through the galvanometer, that is:

$$Q' = \int_0^R V_1\,\frac{(R + y + r - x)^2}{(G + R + y + r)\,(R + y + r)}\,dx$$

$$= \frac{V_1}{(G + R + y + r)\,(R + y + r)} \int_0^R (R + y + r - x)^2\,dx$$

$$= \frac{V_1}{(G + R + y + r)\,(R + y + r)} \left(\frac{(R + y + r)^3 - (y + r)^3}{3} \right)$$

$$= \frac{V_1\,R}{3} \cdot \frac{R^2 + 3R(y + r) + 3(y + r)^2}{(G + R + y + r)\,(R + y + r)}.$$

Similarly we should find that the quantity Q″ flowing out from the portion r of the cable would be:

$$Q'' = \frac{V_1\,r^3}{3\,(G + R + y + r)\,(R + y + r)},$$

and therefore the total quantity Q flowing through the galvanometer will be

$$Q' + Q'' = \frac{V_1}{3} \cdot \frac{R\,(R^2 + 3R(y + r) + 3(y + r)^2) + r^3}{(G + R + y + r)\,(R + y + r)} \quad (1)$$

$$= Q.$$

Now

$$V : V_1 :: \rho + R + x + r : R + y + r$$

is

$$V_1 = \frac{V\,(R + y + r)}{\rho + R + x + r},$$

therefore

$$Q = \frac{V}{3} \cdot \frac{R\,(R^2 + 3R(y + r) + 3(y + r)^2) + r^3}{(G + R + y + r)\,(\rho + R + y + r)} \quad (2).$$

But the total quantity Q_1, which the cable would take if its end were insulated, would be

$$Q_1 = V\,(R + r),$$

or

$$V = \frac{Q_1}{R + r}.$$

Substituting then this value of V in equation (2) we get

$$Q = \frac{Q_1}{3\,(R + r)} \cdot \frac{R\,(R^2 + 3R(y + r) + 3(y + r)^2) + r^3}{(G + R + y + r)\,(\rho + R + y + r)}.$$

Let

$$R + r = L, \text{ therefore } r = L - R.$$

$$R + y + r = L_1, \text{ therefore } y + r = L_1 - R.$$

Substituting these values in the above equation we have

$$Q = \frac{Q_1}{3L} \cdot \frac{R\,(R^2 + 3R(L_1 - R) + 3(L_1 - R)^2) + (L - R)^3}{(G + L_1)\,(\rho + L_1)}$$

$$= \frac{Q_1}{3L} \cdot \frac{R^3 + 3L_1^2 R - 3L_1 R^2 + L^3 - 3L^2 R + 3LR^2 - R^3}{(G + L_1)\,(\rho + L_1)}.$$

By multiplying up we have

$$\frac{3\,Q\,L\,(G+L_1)\,(\rho+L_1)}{Q_1} = L^3 + 3\,R\,(L_1^2 - L^2) - 3\,R^2\,(L_1 - L),$$

therefore

$$R^2 - R\,(L_1 + L) = -\frac{3\,Q\,L\,(G+L_1)\,(\rho+L_1) - L^3\,Q_1}{3\,Q_1\,(L_1 - L)},$$

therefore

$$R^2 - R\,(L_1 + L) + \left(\frac{L_1 + L}{2}\right)^2 = \left(\frac{L_1 + L}{2}\right)^2 - \frac{3\,Q\,L\,(G+L_1)\,(\rho+L_1) - L^3\,Q_1}{3\,Q_1\,(L_1 - L)},$$

that is

$$R = \frac{L_1+L}{2} - \sqrt{\frac{(L_1+L)^2}{4} - \frac{3\,Q\,L\,(G+L_1)\,(\rho+L_1) - L^3\,Q_1}{3\,Q_1\,(L_1 - L)}}.$$

For example:

The conductor-resistance L_1 of a submarine cable which had a partial disconnection in it, was 5,000 ohms. The conductor resistance L, when the cable was perfect, was 2,000 ohms. The discharge Q_1 from the cable, when the end was disconnected, was equal to 300; and the discharge Q, when the end was to earth, was equal to 60. The resistance of the battery ρ being 200 ohms, and of the galvanometer G, 100 ohms. What was the distance R of the fault from the end of the cable?

$$R = \frac{5000+2000}{2} - \sqrt{\frac{(5000+2000)^2}{4} - \frac{3 \times 60 \times 2000}{3 \times (100+5000)\,(200+5000) - 2000^2 \times 300}} = 3500 - 300 \times (5000 - 2000)$$

$3099 = 401$ ohms.

That is, the fault is 401 ohms distant from B.

The formula just given is only correct when the line is free from earth currents; but as this is seldom the case, a correction is necessary in order that the true value of R may be obtained.

Supposing that the electro-motive force of the earth current, whose strength we will call $\frac{V}{n}$, be taken to act in the same direction as the battery current, then at the moment before the key is depressed to take the discharge there will be in the cable, besides the quantity given by equation (2), a quantity q' due to the earth current; this will be

$$q' = \frac{V}{3n} \cdot \frac{R\,(R^2 + 3\,R\,(y+r) + 3\,(y+r)^2) + r^3}{(G+R+y+r)\,(\rho+R+y+r)};$$

but when the key has connected the cable to the galvanometer this quantity becomes changed to

$$q'' = \frac{V}{3n} \cdot \frac{R\,(R^2 + 3\,R\,(y+r) + 3\,(y+r)^2) + r^3}{(G+R+y+r)\,(G+R+y+r)};$$

therefore the quantity discharged due to the earth current will be

$$q' - q'' = \frac{V}{3n}\left\{R\,(R^2+3\,R\,(y+r)+3\,(y+r)^2)+r^3\right\}\left\{\frac{1}{(G+R+y+r)\,(\rho+R+y+r)} - \frac{1}{(G+R+y+r)\,(G+R+y+r)}\right\} = \frac{V}{3n} \cdot \frac{R\,(R^2 + 3\,R\,(y+r) + 3\,(y+r)^2) + r^3}{(G+R+y+r)\,(\rho+R+y+r)}\left(\frac{G-\rho}{G+R+y+r}\right)$$

and the total quantity discharged through the galvanometer will be

$$Q + q' - q'' = \frac{V}{3} \cdot \frac{R\,(R^2 + 3\,R\,(y+r) + 3\,(y+r)^2) + r^3}{(G+R+y+r)\,(\rho+R+y+r)}\left(1 + \frac{1}{n} \cdot \frac{G-\rho}{G+R+y+r}\right) = Q_2$$

or

$$Q_2\,\frac{n\,(G+R+y+r)}{n\,(G+R+y+r) + G - \rho} = \frac{V}{3} \cdot \frac{R\,(R^2 + 3\,R\,(y+r) + 3\,(y+r)^2) + r^3}{(G+R+y+r)\,(\rho+R+y+r)}.$$

From (2) and (3) then, we can see that

$$R = \frac{L_1+L}{2} - \sqrt{\frac{(L_1+L)^2}{2} - \frac{3\,Q_2\,L\,\frac{n\,(G+L_1)}{n\,(G+L_1)+G-\rho}}{3\,Q_1}\,\frac{(G+L_1)\,(\rho+L_1) - L^3\,Q_1}{(L_1 - L)}}.$$

If the earth current is in the opposite direction to the battery current, then n will be negative.

The throw of the galvanometer needle from which Q_2 is determined is due partly to the actual discharge and partly to the continued action of the earth current. If d is the observed throw, and d_1 the observed permanent deflection when the needle has come to rest, then

$$Q_2 = \sqrt{d^2 - 2\,d\,d_1}.$$

(See TELEGRAPHIC JOURNAL, Aug. 15, 1876, page 222.)

For example:

In the first example if the earth current had been one-twentieth of the strength of the battery current, that is, if $n = 20$, and if the throw of the galvanometer needle was equal to 100 divisions (d), and the permanent deflection 18 divisions (d_1), then

$$Q_2 = \sqrt{100^2 - 2 \times 100 \times 18} = 80$$

and

$$\frac{n\,(G+L_1)}{n\,(G+L_1) + G - \rho} = \frac{20 \times 5100}{20 \times 5100 + 100 - 200} = \frac{1020}{1019}.$$

We then have

$$R = \frac{5000+2000}{2} - \sqrt{\frac{(5000+2000)^2}{4} - \frac{3 \times 80 \times 2000}{3} \times \frac{1020}{1019}\,\frac{(100+5000)\,(200+5000) - 2000^2 \times 300}{\times 300 \times (5000 - 2000)}}$$

$= 3500 - 2902 = 598$ ohms. H. R. K.

TOMMASI'S TELEGRAPH APPARATUS FOR WORKING LONG SUBMARINE CABLES.

(*Continued from page* 49.)

When the current ceases to circulate in the electro-magnet *a* the armature *b* is brought back to its place by the counterweight *e*, which, in its turn, producing interruption of the current of the second local pile in the electro-magnet H, naturally brings the armature K back to its place.

It is evident that, inasmuch as the pieces composing the other interrupting relays are identical with those immediately above described, they must produce upon the electro-magnet I the same effect as these latter produce upon the electro-magnet H, from whence it results that when the armature M is attracted, the spur wheel O prints a blue dot upon the same strip of paper.

The two spur wheels L and O, the rotation of which is produced by the clock-work of the apparatus, each rub constantly against a pulley which dips into a trough always full of red ink for the one and of blue for the other.

Although the south pole of the small bar A is covered with platinum, and that the ends of the springs F and G are of gold, and although the current of the local pile which works the two interrupting relays is relatively weak (at most two elements, "Daniell"), the spark which must necessarily flash between the south pole of the small bar A and the ends of the springs F and G at each interruption of the electric current might be injurious to them.

It is precisely in order to avoid this that the armature *b* each time that it is attracted by the electro-magnet *a* automatically breaks the electric current between the spring *g* and the knob or stud *h*, by the aid of the fork *f* the aforesaid current being compelled to pass by *p*, *n*, *h*, *g*, *f*, *m*, to reach the electro-magnet *a*, from whence it issues by I and O to come back to the pile in passing by the spring F, the small bar A, and the fork B; the result is, that the interruption of the current taking place between the spring *g* and the nob *h*, the spark flashes between this knob and this spring instead of being produced between the small bar A and the springs F and G, for it will be well understood that the same manœuvre is repeated upon the other interrupting relay when the current comes back to the pile by the spring G, the small bar A, and the fork B.

The spark which flashes between the spring *g* and the knob *h* does not produce the inconveniences which it would have produced between the small bar A and the springs F and G—

1st. Because the contact between the spring *g* and the knob *h* is much more energetically established than between the small bar A and the springs F and G.

2nd. Because the pieces *g* and *h* not requiring to be delicately and exactly regulated like the pieces A, F, G, they may be easily cleaned from time to time.

When then the knob 1 is pressed there is produced upon the strip of paper a red dot followed by a blue one; when knob 2 is pressed two red dots are produced, each followed by a blue dot; when the knob O is pressed a blue dot is produced followed by a red one, and so on.

By the effect of the pieces T, U, V, W, as well as of the set screws, D, J, R, S, and by means of an ordinary interruptor and a third local pile, an electric striking work may be set at work at pleasure, which will sound a bell with each red and blue dot produced by the receiving apparatus upon the strip of paper.

In applying this system to communications by an an aerial wire, the receiver will, as previously stated, be ordinary "Morse" instrument, and there will only be a single interrupting relay (fig. 5) instead of two.

In this case the piece A will close the circuit of the current of the local pile only when it touches the spring F, and the part played by the spring G will be limited to that of serving as stop to the small bar A at each reversal of the current, which will consequently produce no sign upon the strip of paper of the ordinary "Morse" instrument.

If it is preferred to use the "Morse" code, even in sending messages through submarine cables of very great length, the manipulator will have but two knobs or studs, the one producing upon the strip of paper a red dot followed by a blue one (combination which will represent conventionally a "dot"), and the other producing upon the strip of paper a blue dot followed by a red dot (a combination which will represent conventionally a "dash"), this "dot" and this "dash" referring to the "Morse" code; but it is more useful to produce the nine numbers and the zero. In this case the illimitable cyphers resulting therefrom may be interpreted conventionally, according to the following table, which represents the beginning of a dictionary to be drawn up expressly for this purpose.

Dictionary.

oo, sign to indicate that the numbers which follow it are to be interpreted each for a word.

ooo, sign to indicate that the numbers which follow it should be grouped by two's, each group representing a letter.

oooo, sign to indicate that the numbers following it should be considered as numerical numbers.

01, sign representing a period or full stop .
010 " " a comma ,
011 " " a colon :
0100 " " a semicolon ;
0101 " " a note of exclamation !
0110 " " interrogation ?
0111 " " a hyphen -
001 " " a parenthesis ( )
0010 " " per-centage %

0011, sign to indicate that the word which follows it is underlined.

0	represents	O	24	represents	K
1	"	1	25	"	L
2	"	2	26	"	M
3	"	3	27	"	N
4	"	4	28	"	O
5	"	5	29	"	P
6	"	6	30	"	Q
7	"	7	31	"	R
8	"	8	32	"	S
9	"	9	33	"	T
10	"	A	34	"	U
11	"	B	35	"	V
12	"	C	36	"	W
13	"	C,	37	"	X
			38	"	Y
14	"	D	39	"	Z
15	"	E	40	"	a purchase.
16	"	Ê	41	"	purchases.
17	"	È	42	"	I buy.
18	"	F	43	"	you buy,
19	"	G	44	"	I will buy.
20	"	H	45	"	you will buy.
21	"	I	46	"	he buys.
22	"	Ì	47	"	they buy.
23	"	J	48	"	will you buy?

As will be seen by the preceding table there may be producd without exceeding the use of five figures, 99999 combinations, that is to say, twice as many as are required to express all the words and all the tenses of all the verbs used, not only in the language of commerce, but in ordinary language.

At each end of the line a staff of translators would be provided to reduce into figures the dispatches written in ordinary letters, and, if required, to translate into ordinary language the dispatches received in ciphers.

The dictionary, of which the above table may give an idea, would be drawn up in several languages, care being taken that the same cipher represents the same word and the same tense and person of the same verb in all these languages, according to the desire of the sender, so that his dispatch would be delivered at its destination either in ciphers or translated into the language which the sender would himself indicate.

A SIMPLE ELECTROSCOPE.

M. RAMEAUX lately brought before the Société des Sciences of Nancy a very simple and sensitive electroscope. It consists of a fine fibre of white silk, fixed at one end by means of a little wax to any support, and free to oscillate in any direction under its point of attachment.

A single thread would, of course, suffice for the ordinary purposes of electroscopy properly so called, but it is preferable to employ two near each other, taking care to space them so that they cannot foul each other during their swing, or influence each other reciprocally.

One of the threads is charged to strong repulsions by means of a glass rod charged with positive electricity; the other is charged in a similar manner with a stick of resin charged with negative electricity. Every body which attracts one of the threads so charged, and repels the other, is necessarily electrified. Its electricity is of the same sign as that of the thread which it repels.

The sensibility of these electroscopes is greater, within certain limits, as the threads are made finer, longer, and less conducting.

If the finest sewing silk of commerce be untwisted, each of the parts or strands obtained will make an excellent electroscopic pendulum, which, if about sixty centimetres long, is very handy, and suffices for almost all tests. White silk is preferable to coloured.

The motions of these threads, if well charged, are very considerable, even when the bodies presented to them contain but slight charges of electricity. When the threads are not excessively fine, disturbances of the air do not destroy the observations so much as might be supposed. In the first place, these disturbances can be almost entirely removed; and, furthermore, the threads, even when agitated, obey so well any electric attractions and repulsions that it is absolutely impossible to mistake or detract from their evidence.

M. Rameaux has found this arrangement in all cases more sensitive and sure than a carefully-constructed gold-leaf electroscope, which he used for comparison.

This system also recommends itself in several ways, for instance:

1. It is so simple that every one can construct and use it.

2. It costs nothing; no special support being necessary. The threads can be fixed to any projecting piece, as the edge of a table; the only condition being that they may hang freely.

3. It can be set up in a moment, and consequently is at once ready for any unexpected requirement; whereas a gold-leaf electroscope long unused requires to be dried for hours.

4. It works perfectly, whatever the hygrometric state of the atmosphere.

5. It can be employed to show electric phenomena to a numerous auditory. With long, thin fibres and highly electrified bodies, the experiments are very telling.—*Bulletin de l'Association Scientifique de France.*

ANTOINE CESAR BECQUEREL.

DURING the last month France lost two of her most famous physicists, the elder Becquerel and Victor Regnault. Becquerel died on January 18th, and was buried on the 21st; Regnault died on the 19th, and was buried on the 22nd. From his long series of electrical researches it is in Becquerel that electricians are chiefly interested. He was born at Chatillon-sur-Loing, in the department of Loiret, on March 7, 1788. He was educated at the Polytechnic School, Paris, and on leaving it in 1808, he began life as a soldier by becoming an officer of the Imperial Engineer Corps. He passed at once to active service in Spain, under General Luchet, and was present at the Valencia, Lagonte, Torbosa, and at the taking of Tarragona, where he commanded a column of attack. He afterwards received the rank of captain, and took part in the campaign of 1814. At its close he was rewarded for his remarkable ability and valuable services by receiving the rank of *Chef d' Batallion* and the Cross of the Legion of Honour from Napoleon's own hands. In the peace of 1815 he quitted the army, and resolved thenceforth to devote himself to the pursuit of physical and chemical science, towards which he felt himself impelled by nature and inclination. He became a teacher, and afterwards, in 1837, a Professor of Physics in the Museum of Natural History, Paris, a post which he retained until his death. During the course of his long scientific career, Becquerel has made some valuable researches in meteorological and geological science, especially in the composition of minerals, and the influence of climates on forests; but the great body of his work has been done in the field of electricity and magnetism. He was the first to explain the part played by chemical action in the voltaic cell, and to show that electricity was disengaged in all chemical actions, and particularly in the case of acids acting on metals; the positive electricity appearing on the acid, the negative on the metal. He is also claimed to have been the inventor of the double liquid cell, with porous partitions of clay or membrane.

Electro-chemistry, of which he may be almost said to be the father, was always his favourite field of research. In 1834 he made his crowning discovery

of the electro-chemical deposition of metals by observing that when the two poles of a battery were introduced into solutions of metallic salts a layer of metal was deposited on the negative pole. This discovery, which is the basis of the galvano-plastic art was soon turned to account by De la Rive, of Geneva, who founded upon it his process of electro-gilding in 1840.

Becquerel decomposed, by means of an ingenious reducing cell, known as the *oxygen circuit*, a great variety of minerals, and built up others. Some of his discoveries have been applied to the practical treatment of silver, copper, and lead ores, and to the extraction of the salts of potash from bitter waters.

In thermo-electricity he made a great number of experiments on the currents generated by unequal heating of a single metal, and of two metals in contact, and tabulated the well-known thermo-electric series. These studies led him to the invention of an electro-thermometer, by which the temperature of unattainable places, such as the interior of animal and vegetable bodies, heights in the air, or depths underground, could be registered. Among other inventions of his may be mentioned the differential galvanometer, and an electro-magnetic balance.

In pyro-electricity he found that the property of becoming electric under simple pressure is not exclusively confined to Iceland spar, as, Haing had supposed, but belongs, in greater or less degree, to all bodies. His study of the conditions under which tourmaline shows electric polarity, according as the temperature rises, or falls, or remains constant, is a piece of research which has become classic.

Becquerel was a most indefatigable worker, and made many scattered investigations. Wherever observation or thought invited it, he directed his research. There is consequently a great variety and discursiveness about his results; but at the same time they are pregnant and suggestive.

By means of very delicate apparatus he demonstrated the generation of feeble electric currents in many of the operations of life. He proved the effects of electricity on the colour of flowers to be due to a mechanical bursting of the cells containing the dye, and not to a chemical change. The heating of bad conductors under the influence of the current, and the conductivity of different substances, also formed the subjects of various experiments. During the last ten years he was entirely engaged in studying a remarkable electro-capillary phenomenon observed by him in 1867. A good example of this phenomenon is obtained by immersing a cracked test tube, containing a solution of sulphate of copper in a solution of sodic sulphide; metallic copper is at once deposited in the crack. He found a similar action to take place with many other solutions, and partially enunciated the laws of the process. This investigation is Becquerel's unfinished labour; and small as it appears, it gathers importance in our eyes when we learn that he regarded it as likely to explain the deposition of metal veins in rocks and many physiological reactions which take place in vegetable and animal tissues.

Becquerel was a productive writer as well as an experimentalist. His greatest work is his *Traité Experimental de l'Electricité et du Magnetisme et de leurs Phénomènes Naturels*, in seven volumes, 1834-40. This was followed by three other electrical works, the *Elements d'Electro-chimie appliquée aux Sciences Naturelles et aux Arts*, 1843; the *Traité d'Electricité et du Magnetisme, leurs Applications aux Sciences Physiques, aux Arts, et à l'Industrie*, 3 vols., 1856; and the *Résumé de l'Histoire de l'Electricité et du Magnetisme*, 1858. He was also the author of several treatises on physics, chemistry, meteorology, and numerous scattered memoirs. These are chiefly to be found in the *Comptes Rendus*, and the *Annales de Chimie et Physique*.

He was a member of the Institute of France, a corresponding member of the Royal Society of London, and of the Berlin Academy of Science. He received the Copley Medal from the Royal Society several years ago, and was decorated with the Cross of Commander of the Legion of Honour by Napoleon III., and the Grand Cross of the Order of the Rose by the Emperor of Brazil.

Despite a health apparently feeble, and a frame by no means robust, Becquerel continued active to the advanced age of ninety years, sustained by moral energy and strength of will. His love for work, his keen interest in natural phenomena, and his zeal for research never flagged; while the charming vivacity of his manner continued to the last. He leaves behind him a son, Edmond Becquerel, Professor of Physics in the *Conservatoire des Arts et Métrers*, who has for many years been his father's assistant, and who has proved himself worthy to perpetuate his father's fame.

SAUNDERS *versus* THE POSTMASTER-GENERAL.

AN appeal came before Lords Justices Bramwell, Brett, and Cotton, in the Appeal Court, a few days ago, on a question of compensation payable by the Government to the persons employed by the telegraph companies whose business was transferred to the Post Office under the Electric Telegraph Acts of 1868. It was taken as a representative case bearing on many others and involving an amount of about £20,000. The Act in question empowered the Postmaster-General in purchasing the telegraphs to allow compensation to the clerks of the companies whose services were not retained. In the present case, Mr. John Saunders, who was a district inspector of the Electric and International Telegraph Company, requested the Postmaster-General to assess the compensation he was to receive on the basis of his last year's salary, and the amount paid to him as expenses. The Postmaster-General, however, declined to take the expenses into account, on the ground that they did not form part of the prosecutor's annual salary. Mr. Saunders accordingly applied for a mandamus, and the Lord Chief Justice and Mr. Justice Field, in the Queen's Bench Division, gave judgment in his favour. Against this decision the Postmaster-General now appealed. After hearing the arguments for the Postmaster-General, their lordships, without calling on the other side, were of opinion that the compensation to Mr. Saunders should have been based, not upon his salary alone, but also on what he could save out of the allowance made to him for expenses. They accordingly gave judgment for the prosecutor, and dismissed the appeal.

THE ROYAL INSTITUTION.

THE Friday evening lecture at this Institution on February 1st, was delivered by Mr. W. H. Preece, the subject being "The Telephone." The lecture-hall was crowded to excess, a large number of visitors being unable to obtain admission.

Mr. Preece in commencing his discourse defined the telephone to be an instrument constructed for the transmission of sound to a distance. The art of conveying sound to a distance is as old as the ancient Sphynx. That marvellous people the Greeks practised it; and doubtless it has served to inspire awe in many a poor pagan of simple faith as he reverently kneeled before his idol of stone or of bronze. The earliest authentic account within the historical period of science of the germ of the telephone was shadowed forth by Robert Hooke in 1667, who said:—

"'Tis not impossible to hear a whisper at a furlong's distance, it having been already done; and perhaps the nature of the thing would not make it more impossible, though that furlong should be ten times multiply'd. And though some famous Authors have affirm'd it impossible to hear through the thinnest plate of Muscovy glass; yet I know a way, by which 'tis easie enough to hear one speak through a wall a yard thick. It has not yet been thoroughly examin'd how far Otacousticons may be improv'd, nor what other wayes there may be of quickning our hearing, or conveying sound through other bodies than the Air: for that that is not the only medium I can assure the Reader, that I have, by the help of a distended wire, propagated the sound to a very considerable distance in an instant, or with as seemingly quick a motion as that of light, at least incomparably quicker than that which at the same time was propagated through the Air; and this not only in a straight line, or direct, but in one bended in many angles."

This fancy remained an idea until 1819, when Wheatstone produced his "magic lyre," an arrangement in which sounds were transmitted along a deal rod to whose further end a sounding board was attached. This was the first telephone, and was the precursor of those elegant toy-telephones which are now sold in the streets for a penny.

Mr. Preece then explained the elementary principles of sonorous vibrations, viz., pitch, loudness, and clang-tint, and showed how air-vibrations, in the form of articulate speech, can be actually recorded on paper by Barlow's logograph. The experiments of Page, Gray, Bell, Varley, and Edison, in which sound is produced by electrical vibration, were next alluded to and explained. A very elegant experiment, arranged by Mr. Edmunds, showing how sonorous vibrations can be made to transmit currents of electricity varying in number according to the pitch of note, was then shown. The experiment consisted in placing a Reiss' telephonic transmitter on the current of the primary wire of an inductorium, the secondary wire of which was connected to a rotating vacuum tube; the variation in the rate at which the contacts were made and broken in the transmitter when notes were sounded, or words spoken into it, produced marked effects in the discharge taking place through the tubes. After giving details of the musical telephones of Reiss, Gray, and Edison, and explaining that such instruments could only reproduce the pitch of a note, Mr. Preece showed how the movement of the iron diaphragm in a Bell's telephone produced currents of electricity, a Thomson's galvanometer being employed for the purpose; on any depression of the diaphragm a distinct deflection on the scale was produced. The exact construction of the Bell telephone was then shown by putting together the several parts of which it is composed. By means of wires carried from the Institution to Long's Hotel in Bond Street, the notes of a bugle played at the latter place were distinctly heard by the audience several yards distant from telephones placed at various points of the lecture-hall. Conversations were also carried on between the hall and the hotel.

At the latter part of his lecture, Mr. Preece introduced, for the first time in England, Edison's "Phonograph," an illustration of which we gave in the January 1st number of this Journal. The exhibition of this instrument, of which so much has been heard, produced quite a sensation amongst the crowded audience—a sensation which culminated in loud and continued applause when a sentence spoken into the mouthpiece of the apparatus was reproduced, by turning the handle, in tones sufficiently distinct to be heard all over the hall.

In speaking of the instrument, Mr. Preece remarked: Mr. T. A. Edison, of New York, has crystallised into a fact the ideal of the poet who longed "for the sound of a voice that is still."

The phonograph is but the outcome of the articulating telephone, and though several have added their share in perfecting the "farspeaker," there is no name in connection with it that will shine with greater brilliancy than that of Alexander Graham Bell. His father's occupation of a vocal physiologist led him to study the vocal organs and the production of sound. Helmholtz's researches led him to investigate electricity and its application to telegraphy. The desire to increase the capacity of wires for the conveyance of messages led him to devise systems of multiplex telegraphy and this by steady and sensible degrees led him to articulate telephony. We have here a notable example of the modern method of research where imagination suggests experiment, and experiment by evolution produces growth and perfection. Things that are new are not always accepted as true. The accounts of the telephone were received in this country with great scepticism. Many even now doubt its truth until they actually test its reality. When once, however, a new thing is shown to be true, a host of detractors delight in proving that it is not new. The inventor has to pass through the ordeal of abuse. He is shown to be a plagiarist or a purloiner, or something worse. Others are instanced as having done the same thing years ago, though perhaps their own existence, apart from their ideas, have never been before heard of. Professor Bell will have to go through all this; nevertheless, his telephone will always be associated with his name, and it will remain one of the marvels of this marvellous age, while its chief marvel will be its beautiful and exquisite simplicity.

Notes.

TELEPHONIANA.—A letter from Mr. W. J. Millar, C.E., of Glasgow, recently appeared in two of our contemporaries, announcing the somewhat startling discovery that Mr. Millar had succeeded in constructing a telepone which operated without the agency of magnetism. Shrewd people suspected that this was nothing more than a re-discovery of the pill-box telephone well-known to Macaulay's schoolboy; but so many mysterious things have been told of this uncanny instrument, that cautious people have been looking for further intelligence about the matter. It now appears that although the principle is the purely mechanical principle of the pill-box contrivance, it has been so well applied by Mr. Millar, that conversation, pianoforte music, and songs are transmitted over a wire about fifty yards long with great distinctness. The wire may be bent round the angles of a house without interfering with the vibrations. A great deal depends on the way in which the wire is fitted up, its quality, and the adaptation of the mouth-piece and disc. Next to inventing an instrument on a new principle is the practical improvement of one already known, and Mr. Millar will do good service if he succeeds in lifting, what has hitherto been regarded as a child's toy, to the level of an appliance useful in the business of life.

WE believe that telephonic communication between the offices of the *Times* and *Daily News* and the House of Commons, is now established.

SUCCESSFUL speaking has also been carried on between Wick and Kirkwall over the Pentland Firth Cable.

THE TELEPHONE IN GERMANY.—Dr. Stephan, the Director-General of Postal Telegraphs, North Germany, has issued printed instructions as to the use of the telephone. Special offices in connection with the ordinary telegraph office will be opened for telephonic messages. When a telephonic message is to be sent, the telephone office will request the other office to connect up for telephone sending. The sender is enjoined to speak slowly, clearly, and without forcing the voice, the syllables being carefully separated and all accurately pronounced. A pause is to be made after each word to allow the receiving operator to write it down. The latter verifies the number of words sent and rapidly repeats the message as he received it for correction. To ensure secrecy, the telephones are kept in a private office, and the operators are forbidden to disclose the names of the parties to the message. The charge is fixed at so much per word as in ordinary messages.

WE prophesied (says the *Scientific American*), even better than we knew the other day, when we said that the adoption of so short a name as "Fernsprecher" for the telephone by the Germans was a matter for congratulation, because they would otherwise soon find a way of smothering it under some frightfully polysyllabic title. To shew how closely the fortunate instrument has escaped this fate, a correspondent in Heidelberg, writes us that no less than fifty-four names were proposed in German, all of varying degrees of length and atrocity. Some (we will not inflict the reader with the original titles) signified "mile tongue," "kilometre-tongue," "speaking post," "word lightning," "world trumpet," and finally one inventor, collecting all his energies for a grand effort, triumphantly produced "doppelstahlblechsungensprecher."

Our contemporary adds a useful hint to the effect that the jaw can be replaced by pressing on the lower molars with the fingers, and guiding the muscles with the thumbs.

THE French Academy of Sciences propose to award the Marshal Vaillant prize in 1879 for the best solution of the problem—to perfect the phonetic telegraph in some important point. The sum bequeathed in 1873 by the Marshal Vaillant to found the prize was forty thousand francs, and the Academy have decided to offer the prize every two years.

TELEPHONES are being sold at 3s. each in Vienna. We hear that over 5,000 telephones have now been made for Messrs. Bell and Reynolds by the Silvertown Telegraph Company.

RESISTANCE OF HORN CARBON.—M. Salet has found that horn carbon gives far greater variations of electric resistance under pressure than graphite, and it is expected that it will therefore take the place of the latter in telephones constructed on Mr. Edison's principle.

IT is proposed to erect a monument to the memory of Ruhmkorff, who, although a Hanoverian by birth, is regarded as a Frenchman by the French people, inasmuch as his powers were developed in France.

THE ELECTRIC LIGHT AT THE PARIS EXHIBITION.—The machinery for producing a powerful electric light is being installed on the bridge of Concord, Paris. The light is intended to illuminate all that part of the Seine about the bridge, and the whole front of the Palace of the Trocadéro.

M. CHIKOLEFF, of St. Petersburg, by a series of experiments for the Russian War Office, confirms the results of the recent South Foreland trials of magneto-electric machines, and recommends the electro-deposit of copper on the carbons.

AN exhibition of new inventions has been opened in the Palais de l'Industrie, Paris. It is purposed to continue it annually, and it promises to be popular and commercially successful.

AN ingenious pen, penholder, and inkstand combined, has been brought out by Messrs. Letts & Co., of diary celebrity. It contains a supply of ink for about two months, can be recharged when exhausted, and is not larger than the ordinary pocket penholder.

APPLICATION OF THE TELEGRAPH TO THE HERRING FISHERY.—During the fishing season the herring schools enter the fiords of Norway at quite unexpected times, and at places where there are often only one or two fishing boats, and it frequently happens that before the neighbouring boats can be warned, the herrings have deposited their spawn, and returned again to the open sea. To prevent these oft repeated disappointments, and the losses which result from them to the fishers, the Norwegian Government has established over a length of 200 kilometres of the coast frequented by the herrings, a submarine cable, with land stations, at intervals sufficiently close and communicating with the fishing village. When the school of herrings is perceived in the offing, and it can always be recognised at a certain distance by the ripple which it raises, a telegraphic message, sent along the coast, announces to each village the fiord or bay into which the herrings have penetrated.—*Count du Moncel.*

IN Paris, the merchants and clubs now have an instrumental delivery of all political, market, bourse and general intelligence on printed slips direct, and without any delay whatever, through the medium of the Havas agency. This is a great improvement on the system now in use in London clubs, and should be adopted in them at once. Perhaps the Exchange Telegraph Company will take steps to see it carried out.

THE Bahia-Rio Janeiro Cable is interrupted and messages will be forwarded to Rio by steamers leaving Bahia. The enforced delay of messages will thus be about three days.

TELEGRAPHIC TARIFF IN FRANCE.—A bill has been presented to the French Chambers to effect the reduction of the rate charged for messages throughout France to 5 centimes or ½d. per word, with a minimum of 50 centimes or 5d. for any message. The present minimum is 60 centimes in Paris, and 140 centimes throughout France per 20 words. To provide for the probable increase of correspondence due to such a reduction of charge, a supplementary credit of 3,309,810 francs would be opened, 949,810 francs of which being destined for the *personnel*, and 2,369,000 for material and new works.

A NEW AMERICAN TELEGRAPH Company.—The "Continental Telegraph Company" has been formed in New York by parties who have been prominently connected with the Atlantic and Pacific Company. The capital is placed at 10,000,000 dollars. Right of way through New Jersey has been obtained for the new line to Philadelphia and Washington, and the works have already been commenced. The first line will run from New York to Philadelphia, and will consist of five wires, the size of the wire being No. 6, with poles 30 feet in height and 7 inches in diameter at the top; 40 poles to the mile. The second line will run from New York to Baltimore and Washington, and will also consist of five wires. Business will probably be opened about the first of April next. One of the new features to be introduced will be a combination of the Morse instruments and the telephone. Lines will be extended only to points where the amount of business will warrant them, and the best of materials will be used in construction.

DR. KERR'S EXPERIMENT.—The following experiment made in Berlin by Mr. J. Mackenzie at the instance of Helmholtz is given in the *Poggendorf's Annalen*, No. 11. A glass plate 12 millimetres thick, coated on opposite sides with tin foil, is supported and covered with larger glass plates. The foil is connected to the poles of a Holtz machine, or a Ruhmkorff coil. The glass plate is placed between two Nicol's prisms, as in Dr. Kerr's famous experiment, and a beam from a lamp sent through the polarising arrangement. When the foil was charged by the machine or coil, no increase of brightness was perceptible, even when polarised sunlight was employed instead of the beam from a lamp, or when a mica leaf, yielding the violet tint, was interposed between the glass plate and analyser. Experiments with oil of turpentine in place of glass also gave no positive results. Its is therefore concluded that Dr. Kerr's result is only due to electrification, in a secondary sense, through the heating effect it produces. It may be remembered that the maximum effect in Dr. Kerr's experiment was only obtained thirty seconds after putting on the current, and that the phenomenon disappeared as slowly on breaking circuit.

CIRCULAR MAGNET.—M. Duter recently exhibited, at a meeting of the French Physical Society, some circular steel discs, which he had magnetised by applying the pointed poles of an electro-magnet to their centre. In these magnets the neutral line between the north and south poles is a circle concentric with the circumference of the disc, and the quantities of north and south magnetism are equal on opposite sides of this equator.

THE DIFFERENCE OF POTENTIAL produced by the passage of water in capillary tubes, has been the subject of recent experiments by M. Haga, and by Mr. J. W. Clark, in Germany. For an account of them see *Poggendorff's Annalen*, No. 11, 1877. In each set of experiments a quadrant electrometer was employed to measure the difference of potential or electro-motive force generated. According to M. Haga, this difference is proportional to the pressure, and increases with the resistance of the water, and probably also with the temperature. It is also believed by him to be independent of the length of the tubes, but dependent on the nature of the inner surfaces. Mr. Clark is of opinion in very narrow tubes, the difference of potential is independent of the length, but in wider tubes it decreases with the length. He also finds that the narrower the bore of the tube the greater is the difference of

potentials produced when a liquid, as water, is forced through it; that the difference depends on the substance forming the interior of the tube, and that the seat of the electro-motive force produced is the surface of the liquid, and the inner wall of the tube. The original difference of potentials decreases with time, but may be restored on cleaning the tube with sulphuric acid and distilled water.

DIMENSIONS OF LIGHTNING RODS.—The following results are published by Dr. Nippoldt of the Observatory of Paris. The existing errors with regard to the proper dimensions of lightning-rods are traceable to Kuhn's *Encyclopedia of Physics*, which gives the thickness for a conductor of iron 64 feet long as half an inch, and states that for other metals, such as copper or lead, the section ought to be proportional to the resistance of the metal.

The lightning conductor ought to fulfil two conditions:

1. To draw the current to earth.

2. To have sufficient sectional area to lead away the discharge without an injurious rise in temperature.

The elevation in temperature depends on the intensity of the current and the conductivity of the rod. Let W be the heat developed, J the intensity of the current, R the resistance of the rod; then

$$W = J^2 R. \quad (1)$$

Again, let l be the length of the conductor, g the cross-section to be found, s the density of the conductor, w its specific heat, r its specific resistance, M its mass, and t the temperature; then from the electro-dynamic law it follows that

$$R = \frac{l}{g} r \quad (2)$$

and

$$W = J^2 . \frac{l}{g} r \quad (3)$$

and the mass M, which receives the total heat W, is raised to the temperature

$$t = \frac{W}{Mw} \quad (4)$$

and as $M = lgs$, by substituting this value in equation 4, we have

$$t = \frac{W}{lgsw.} = \frac{J^2 . r}{g^2 sw} \quad (5)$$

Temperature is independent of the length of the rod. The four metals employed as lightning conductors are

Metal.	Specific Heat.	Density.	Resistance.
Iron	0·1138	7·75	0·0986
Copper	0·0951	8·95	0·0162
Lead	0·0314	11·35	0·0199
Platinum	0·0324	21·54	0·0918

An iron conductor of 144 square millimetres ought therefore to be equalled by a copper conductor of 90 square mm., by a lead one of 320, and a platinum one of 156. M. Kuhn's gives the corresponding dimensions as 24 for copper, 230 for lead, 134 for platinum.

The resistance of copper (0·0162) given above is on the supposition that the metal is chemically pure. According to Dr. Mathiessen, the resistance is tripled if the metal contains ½ per cent. of iron. It is necessary to use copper containing not more than 2 per cent. of iron, and giving only one-fifth of the resistance of iron—that is, 0·0197 resistance instead of 0·0162.

The end of the rod should terminate in a platinum point two or three millimetres thick, having from three to seven square millimetres of section. A platinum point of this size will be heated from 2,000 to 500 times more than the rod itself, and if the passage of the current raises the temperature of the rod only 4° C. the platinum point will melt.

ELECTRIC AFTER-CURRENTS IN IRON RODS.—It was discovered by Villari that if a rod of iron or steel through which a current has passed be agitated, an after-current is again set up in the same direction as the original current. He explained the phenomenon on the hypothesis that the rod is transversely magnetised by the current, and employing Ampere's theory of molecular currents, that these currents arrange themselves in concentric circles round the axis of the rod. Now, when the rod is agitated after the interruption of the current, the molecular magnets tend to mingle themselves irregularly again, and in doing so generate an induction current called by Villari an "agitation current." Prof. H. Streintz, at the Royal Academy of Sciences of Vienna, has recently, shown how to calculate the magnetic force exerted on the molecular currents by the original current in the rod. The problem is a case of Biot and Savart's theorem, that a rectilineal current of infinite length acts upon a pole of a magnet with a force inversely proportional to the perpendicular distance of the pole from the conductor. In the case in question we have to calculate the action of a circular surface (the rod being cylindrical) with uniform mass upon a mass-point situated in the surface. But a circular line with uniform mass exerts no action on a point situated in the enclosed surface, while it acts on an external point in the same plane as if the mass of the circle were collected in the centre. Therefore the force exerted upon a magnetic pole situated at the distance r from the axis, $p = \frac{k r}{a^2}$, in which k is a constant, and a the semi-diameter of the rod. The total moment upon all the molecular magnets contained in the rod is then $R = K l a$ where K is a constant and l is the length of the rod.

THE length of the recently-opened line to Western Australia, from Adelaide to Perth, is 2,046 miles; and when it is considered that the greater part of the country thus traversed is a sandy, waterless track, it will be seen that the undertaking evinces no little pluck and pains on the part of both South and Western Australia.

POST OFFICE TELEGRAPHS.—The revenue of the Post Office Telegraphs for the year ended the 31st day of March, 1877, amounted to £1,328,315, from which £1,120,211 had to be taken for salaries, wages, maintenance, &c., and £13,290 as a contribution to a depreciation fund to replace submarine cables. This left a balance of profit of £194,814, equal to 1·97 per cent. on a capital of £9,845,278.

THE Western and Brazilian Telegraph Company, Limited, intimate that the s.s. *Calabria*, belonging to the Telegraph Construction and Maintenance Company, Limited, sailed on the 10th inst. for Maranham, with cable for the purpose of putting Maranham and Pernambuco in telegraphic communication and replacing the portion lost in the *Hibernia*.

Patents.

251. "Improvements in electric telegraph conductors and apparatus for their manufacture."—C. W. SIEMENS, Jan. 19.

275. "An arrangement of semi-automatic apparatus for transmitting telegraph messages by the Morse system."—T. J. SMITH (communicated by M. le Comte E. Liccardi), Jan. 21.

291. "Apparatus for communicating signals in connection with electric telephones."—J. H. MCLURE, Jan. 23.

307. "Telephones."—D. PIDGEON, Jan. 23.

308. "Galvanometers and relay apparatus for electric telegraph purposes."—L. A. BRASSEUR, S. W. M. de Sussex, Jan. 23.

312. "Improvements in the manufacture of submarine telegraph cables, whereby their gutta-percha or other insulated cores are protected from the ravages of insects."—N. CLIFFORD, Jan. 23.

324. "Improvements in medical galvanic apparatus applicable to the human body."—B. SCARLES, Jan. 24.

333. "Improvements in controlling time-keepers by electricity, and in apparatus therefor."—F. J. RITCHIE, Jan. 25.

375. "Improvements in the manufacture of insulated telegraphic conductors, and of insulating materials to be employed therein, which materials are also applicable to other purposes."—E. T. TRUMAN, Jan. 29.

405. "Improved apparatus for reproducing musical and other sounds by electricity."—A. M. CLARKE (communicated by C. L. Weyher), Jan. 30.

408. "Improvements in means and apparatus for controlling and localising electric currents for the transmission of electric signals and messages."—Z de BEJARY O'LAWLOR, Jan. 31.

446. "An improvement in illuminating objects to be photographed, and the interior of public and other buildings."—H. V. WEYDE, Feb. 2.

471. "Manufacture of carbon electrodes."—M. GRAY (communicated by N. E. Reynier), Feb. 5.

491. "Improvements in apparatus for transmitting and indicating signals and orders, parts of which improvements are applicable as a new mechanical motion to other useful purposes."—H. F. JOEL, Feb. 6.

492. "New or improved battery rheostats, specially applicable for medicinal purposes."—S. J. COXETER, Feb. 6.

ABSTRACTS OF SPECIFICATIONS.

430. "Improvements in Electric Telegraphs."—A communication from J. J. ETIENNE LE NOIR, Paris, dated, Feb. 1, 1877. 6d. This relates to writing or copying telegraphs, and includes an improved governor for enabling the sending and receiving styles to keep synchronous in their action. When the speed of the governor is too high the arms fly apart, and establish a circuit which subjects the spindle to electro-magnetic resistance. In order quickly to "discharge," or "empty" the line, a reverse pole of feeble tension is applied to the line in place of earth. The message is written in non-conducting ink, upon metallic paper, wound round a cylinder, and is transmitted by the passage of a style across the paper. It is received by a style or marker on white paper, the style being actuated by electro-magnetism produced by the line currents.

492. "An improved apparatus for generating electricity and motive power."—PAUL JABLOCHKOFF, Paris, dated Feb. 5, 1877. 6d. This consists in a novel form of voltaic battery, in which the current is produced by the reaction of fused nitrates upon carbonaceous matter, the latter constituting the negative pole, and the former the positive pole. The gas generated by the action of the cell are utilised as a source of motive power by conducting them in a closed pipe from the cell to a reservoir. These gases are similar in their nature to those produced by the explosion of gunpowder.

515. "Improvements in telegraph posts, and in the method of fixing the same."—J. M. NERMAN, dated, Feb. 7, 1877. 4d. This consists in forming light and strong telegraph posts by driving two uprights of angle or trough iron into the ground, a short distance apart, and tying them together at the top by cross bars, perforated with holes for the reception of insulators. In soft ground, the base of the poles in the hole is filled round with concrete, cement, or asphalt.

522. "An improvement or improvements in fixing the insulators of electric telegraphs."—J. H. CORDEAUX, Feb. 7, 1877. 6d. By this plan the bolt supporting the insulator is formed with a screw thread at its end, and screws into the insulator, a washer of india-rubber or other yielding material being placed on the screwed end of the bolt so as to be compressed between the insulator and the shoulder on the bolt, when the insulator is screwed home. This serves to keep the insulator tightly on. The insulator may be readily removed by unscrewing.

653. "Improvements in electric bell and thief-detector."—A. G. STOCKWELL, dated Feb. 17, 1877. 6d. The object of this invention is to save the time and inconvenience necessary for readjusting the indicators now used, to give a longer action to a self-adjusting indicator, and to indicate which part of the house is being entered by burglars. The closing of a circuit is made to attract a pendulum, which rings the alarm bell, and by its subsequent oscillation, on being freed, indicates the quarter of the house the alarm comes from.

691. "Improvements in Electric Telegraphs."—J. C. L. LOEFFLER and R. W. N. P. HIGGS, dated Feb. 20, 1877. 1s. This consists in a means of overcoming the retardation of signals on submarine cables, arranging connections for duplex working, and to instruments and codes used in telegraphing. The receiving instrument is connected to the line by means of a "bridge"

arrangement of resistances (and perhaps also with capacities) so adjusted, that it does not signalise except when an electrical impulse is transmitted from the sending station. The new signalling code consists of combinations of dots and dashes and intervals, arranged in two parallel lines, so that between the two marks constituting each signal the intervals of space are obviated Relays with balanced coils, suspended in circular magnetic fields and working tongues between contacts, are described; the relay tongue having a sliding shuttle so arranged as to make contact on either side by a small movement, without limiting the stroke of the tongue. A sending key with a rocking lever, so arranged that successive depressions of the key cause contacts to be made for transmitting currents from separate sources alternately, is also described.

732. "Improvements in electro-magnetic engines."—J. H. LOVEL, dated Feb. 22, 1877. 6d. This consists in forming an armature disc of soft iron on a shaft, and surrounding it with electro-magnets capable of attracting the disc so as to start and maintain the shaft in rapid rotation.

TRAFFIC RECEIPTS.

Name of Co., with amount of capital, exclusive of preference and debenture stocks.	Anglo-American Co. £7,000,000.	Brazilian Sub. Co. £90,000.	Cuba Sub. Co. £16,000.	Direct Spanish Co. £13,000.	Direct U.S. Co. £65,000.	Eastern Co. £369,700.	Eastern Ex. Co. £190,750.	Gt. Northern Co. £125,000.	Indo-Euro. Co. £17,000.	Submarine Co. £338,225.	West Coast America Co. £300,000.	Western and Brazilian Co. £69,910.	West India Co. £88,350.
	£	£	£	£	£	£	£	£	£	£	£	£	£
January, 1878 ...	49,940	11,877	*3,000	976	13,730	41,531	22,905	13,480	... ...	9,621	1,725	10,419	*5,200
January, 1877 ...	37,780	11,587	2,311	983	13,530	42,580	24,147	12,676	... ...	9,668	2,533	10,342	4,058
†Total Inc. 1878	12,160	290	*689	... ...	200	... ...	... ...	804	... ...	... ...	... ...	77	*1,142
†Total Dec., 1878	... ...	... ...	... ...	7	... ...	1,049	1,242	... ...	... ...	47	808	... ...	... ...

* Estimated. † Compared with same period 1877.

Correspondence.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—Since Mr. R. A. Proctor has disowned the authorship of an article on the "New and Wonderful Phonograph" (and even of another effusion on the "Manufacture of Soap") which I in a recent critical note of mine in your columns ascribed to his ubiquitous pen, I now write for the purpose of frankly acknowledging my slight error. The paragraph in question appeared in the "Popular Science" columns of the *Echo*, and that my error in attributing it to Mr. Proctor was really slight and excusable, will appear from the fact, that until quite lately these columns were signed with that gentleman's well-known initials "R. A. P." Though the outer sign was no longer manifest, it was pardonable to suppose that the inspiration of these columns was the same, and I am certain that many readers of the *Echo* will be surprised to learn that the "Popular Science" articles are not Mr. Proctor's. I can assure Mr. Proctor that many of his admirers were of opinion that a recent article on the "Food Value of Soup" was by his hand, and it will, no doubt, be a matter of grievous disappointment to them to hear that it is not.

Mr. Proctor points out that he has not written in the *Nineteenth Century*. I did not expressly say that he did; but at any rate the *Contemporary Review* is the parallel periodical, and if the matter be of so much importance, I willingly correct the former into the atter.

Electricians will be somewhat surprised to hear that the remarkable assertion of Mr. Proctor in the *Gentleman's Magazine* to the effect that ere long we should be able to whisper through the Atlantic cables by means of the telephone was "based on a statement of Sir W. Thomson's." The only statement of the kind I have heard as coming from Sir W. Thomson was a remark that it would soon be possible to talk through "several hundred miles of wire" (meaning land-line, of course). A great deal may be "based" on any statement; and if the great practical distinction between submarine cables and air-lines is not taken into account, it is easy to see how Sir William Thomson's words may mislead.

It will be news to electricians also to learn that Sir William Thomson is not a "professional electrician." I believe I am right in considering that the man who was a chief electrician on board the *Agamenon* during the laying of the early Atlantic cable, and lately acted as engineer for the Western and Brazilian, the Platino-Brazilliero, the West India and Panama, and the Cuba Submarine Company's cables, is a professional electrician as well as a scientific one.

When Mr. Proctor confines himself to matters of astronomy, mathematics, and theology, and deals his vigorous blows at cliquism, or breaks a lance in defence of public right, no one more admires and respects his writings than I do; but when he ventures into the unfamiliar field of telegraphy, he must expect to encounter the criticism of the specialist. Were his authority and ability less, his licence to make bold assertions might with impunity be greater. It is an old, but a wise proverb, which forbids the cobbler to

forsake his last; and although there is a vast difference between enlightenment and leather, I suppose that what applies to the shoemaker applies also to the man of science.

Mr. Proctor speaks of my former remarks as having been conceived in a peevish and petulent spirit. I can assure him that I never enjoyed better humour in my life than while I wrote them.

THE WRITER OF THE "NOTE."

To the Editor of THE TELEGRAPHIC JOURNAL.

DEAR SIR,—Referring to your Editorial of Dec. 15 last, headed "Progress of Electrical Science in England and America," in which you combat the assertion of Mr. Latimer Clark that "English telegraphists are allowing themselves to be beaten by their American rivals, the said assertion having been made in consequence of the great stir and excitement that has been created by the successful working of "The Telephone and Quadruplex Telegraph System," I wish to claim for Canada in particular, and the British people generally, that the telephone was invented by a Canadian, namely, Mr. A. Graham Bell, from Brantford, Ontario, and that the first experimental instrument was made in Canada by a Canadian artisan.

I also wish to claim that Mr. Thomas A. Edison, the inventor of the Quadruplex, Articulating Telephone, Phonograph, Electric Pen, &c., whom you style the distinguished American electrician, is also a Canadian, from St. Thomas, and afterwards Sarnia, Ontario.

These gentlemen gravitated, the one to Boston, and the other first to Boston and then to New York, precisely as on your side of the water those who think they have a mission, or can make their mark, gravitate to London.

I enclose the *Brantford (Ontario) Daily Expositor* of the 19th inst., containing the report of a lecture by Prof. A. Melville Bell (the father of Mr. A. Graham Bell, the inventor), on the Telephone.

The "Tutels Heights" referred to in the lecture is the residence of the lecturer, and I believe the early home of the inventor; it is about three miles distant from Brantford, and is connected with Prof. Bell's town office by a telephonic wire.

I trust you will find room for the lecture in your interesting journal, and thus put on permanent record, in M. A. Melville Bell's own words, that "Canada is the birth-place of the Telephone."

Yours truly,
BEN. B. TOYE.

Toronto, Canada, Jan. 24, 1878.

[We are sorry that want of space prevents us printing in its entirety the report referred to, but the following verbatim extract will be interesting:—"*Canada is the birth-place of the telephone*, and the first experimental instrument was made by a Brantford artisan some five or six years ago. Nearly 4,000 are now in use in the United States, and most of Europe has adopted it in various ways. The first line in Canada was between Rideau Hall and the Premier's office, Ottawa. The Brantford line was the third one erected."—EDIT. TEL. JOUR.]

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—Referring to my letter of the 20th January, I beg to inform you that it has been ascertained that the interruption to the short section of this company's cable between Torbay, Nova Scotia, and Ryebeach, New Hampshire, was caused by its being hooked and broken by the anchor of the schooner *William H. Raymond*, Captain Swim, belonging to the port of Gloucester, Massachusetts.

The captain of the schooner furnished this information.

I am, Sir,
Your obedient Servant,
CHARLES CLARKE,
Secretary.

The Direct United States Cable Company, Limited, London, E.C.
9th February, 1878.

To the Editor of THE TELEGRAPHIC JOURNAL.

Sir,—In your issue of 1st February, we notice a letter from Mr. W. B. Woodbury in which our names are mentioned. This gentleman must excuse us if, while disclaiming for ourselves any part in the invention of the *modus operandi* referred to, we yet fail to recognise the validity of the claim he has made on his own behalf to it. It will, we think, be sufficient to refer him to the *British Journal of Photography*, 5th May, 1876, where in a special article by the Editor, it is accredited to Mr. Paul. If Mr. Woodbury can refer us to any Journal wherein he published it prior to this date, his claim will be indisputable; if not, we hope he will (on the principle of the 11th commandment), drop a claim he cannot substantiate, and give the credit to the proper party. We send you herewith copies of the *British Journal of Photography*, 5th May, 1876, and 18th August, 1876, and if you will compare the leading article to the former with an extract from a publication of Mr. Woodbury's in the latter, you will see at once the two methods are identical in principle and practice, in fact they are *one* and the same.

Yours obediently,
WRATTEN & WAINWRIGHT.

London, W.C., February 10th, 1878.

TRINIDAD.—The price of a set of telephones is £25. Each set consists of a pair of telephones and a call bell on a stand—the equipment for one end of a line. The senders and receivers cannot, we believe, be purchased separately. The apparatus can be worked on an ordinary suspended wire, provided other working wires do not run on the same poles with it; if they do, it is difficult to hear distinctly, while the wires are working, from a peculiar crackling noise which is heard, and which is due to induction from wire to wire. Full particulars as to terms, &c., can be obtained from the agent, COL. REYNOLDS, 115, Cannon Street, E.C.

Proceedings of Societies.

PHYSICAL SOCIETY.—2ND FEBRUARY, 1878.

ANNUAL GENERAL MEETING.

The President, Professor G. C. FOSTER, in the Chair.

The President read the Report of the Council for the past year. After pointing with satisfaction to the present condition of the society, the report goes on to show how it is hoped to extend its usefulness in the future. In addition to a second edition of Professor Everetts' work on the C.G.S. System of Units, the Council hopes very shortly to publish Sir Charles Wheatstone's papers in a collected form, and it is making arrangements for the publication, at intervals, of translations of foreign scientific papers, especially such as have had a marked effect on the progress of physical science. A portion of

the funds of the society is to be devoted annually to the formation of a library, and an exchange of publications is already made with various learned societies abroad. Special stress was laid on the distinctive object held in view at the formation of the society, namely, the exhibition, when practicable, of the experiments referred to in papers read at the meetings.

The following officers and council were elected for the ensuing year:—*President*, Professor W. G. Adams, M.A., F.R.S.; *Vice-Presidents* (who have filled the office of President), Dr. J. H. Gladstone, F.R.S., and Professor G. C. Foster, F.R.S.; *Vice-Presidents*, Professor R. B. Clifton, M.A., F.R.S., W. Spottiswoode, LL.D., F.R.S., W. H. Stone, M.B., F.R.C.P., Sir W. Thomson, LL.D., F.R.S.; *Secretaries*, Professor A. W. Reinold, M.A., W. Chandler Roberts, F.R.S.; *Treasurer*, Dr. E. Atkinson; *Demonstrator*, Professor F. Guthrie, Ph.D., F.R.S.; *Other Members of Council*, Capt. W. de W. Abney, R.E., F.R.S.; Professor W. F. Barrett, F.R.S.E.; Major E. R. Festing, R.E.; W. Huggins, D.C.L., F.R.S.; Professor A. B. W. Kennedy, C.E., O. J. Lodge, D. Sc., Professor H. M. McLeod, the Earl of Rosse, D.C.L., F.R.S., Professor W. C. Unwin, B. Sc., R. Wormell, D. Sc.

Professor H. L. F. Helmholtz and Professor W. E. Weber were elected honorary members of the society.

After votes of thanks had been passed to the Lords of the Committee of Council on Education for the use of the Physical Lecture Room at South Kensington, as well as for the other advantages enjoyed by the society, and to the several officers of the society, the meeting was resolved into an ordinary one.

The following candidates were elected members of the society:—M. S. Cormack, C. J. Faulkner, M.A., E. M. Jones, F.R.S., C. Leudesdorf, M.A., and C. E. Walduck.

Professor S. P. THOMPSON exhibited a method of showing the lines of force due to two currents of electricity running in parallel directions. A plate of glass is perforated by two holes close together, which are traversed by one and the same wire, and this may be so arranged that the current traverses the parallel lengths in the same or opposite directions. If now the plate be held horizontally while the current passes, and fine iron filings be sprinkled on the plate, they will arrange themselves in the well-known forms. In the plates exhibited, the filings had been fixed by gum, so that their arrangement could be exhibited to an audience by projection on a screen.

General Science Columns.

MINUTES OF PROCEEDINGS OF THE INSTITUTION OF CIVIL ENGINEERS, SESSION 1876-77. PART II.—The first paper in this volume on "The Repairs and Renewals of Locomotives," by Mr. McDonnell, deals principally with statistics compiled from the author's own experience on the Great Southern and Western Railway of Ireland, though it also contains sound, valuable tables on the same subject obtained from the principal railways in England, and some foreign railways. Such papers are useful for reference, and of special value to locomotive superintendents, as showing the comparative outlay on the various lines, and in what respects economy might be practised.

It is, however, very difficult to institute a perfect comparison between any two railways, as the gradients, the mode of working, and the method of keeping records and accounts differ considerably. Thus in the discussion on the paper, the late Mr. J. Armstrong, for several years locomotive superintendent of the Great Western Railway, showed that in consequence of so much of the work being done at the railway's workshops at Swindon, many items appeared under the head of wages in the Great Western returns which appeared under the head of materials in the tables furnished by the author. Mr. Armstrong also showed that the worst gradients on the Great Western were considerably steeper than those on the Great Southern and Western, rendering a comparison unfavourable to the former railway. The cost of renewals and repairs of engines on five of the principal railways in England and the Irish railway referred to was between 2½d. and 3½d. per train mile.

The second paper treats of the "Utilisation of Refuse Vegetable Substances as Fuel for Agricultural Steam Engines." In England coal is cheaper than any other fuel, and straw, if employed as fuel, would cost about five times as much as coal; but in many countries, where coal is not found and carriage is difficult, the state of the case is exactly reversed. In Russia, Hungary, India, South America, and other countries the cost of coal as fuel is about three and a half times as much as straw. The objections to the use of vegetable refuse as fuel are, the necessity of constant feeding of the fire owing to the bulkiness of the fuel and the rapidity of consumption, the tendency to check the combustion by the introduction of damp fuel, and the deposition of silica on the bars of the grate. These difficulties have been surmounted in the machines described in the paper, by providing an automatic feeding apparatus which inserts the fuel in a fan shape into the furnace, pushing forward the fuel in front gradually into the middle and further end of the furnace where the combustion is most active, and the deposits of silica is constantly removed by a rake working along the bars before it has had time to harden. These machines are specially suitable for burning straw, reeds, brushwood, cotton stalks, and the refuse of sugar cane.

The third paper in the volume is "On the Sewage Question," a subject which, in one form or other, is from time to time brought forward at the meetings of the Institution, and invariably produces an animated discussion, as the parties of the various systems in use, or proposed for the disposal of sewage, are eager to promulgate their views. The paper before us discusses freely the merits of the principal systems which are classified as follows. (1) Treatment with chemicals. (2) Application of sewage to land, including irrigation and intermittent downward filtration. (3) The dry earth system. (4) The Liernur or pneumatic system. (5) Seaward and tidal outfalls. The first is condemned as costly and impracticable, except as subsidiary to investigation; the second is approved of where land can be readily procured; the third is considered inapplicable for dealing

with the sewage of towns; the fourth is condemned; but unqualified approval is given to the fifth, as applicable to all towns within the tidal range of rivers or on the sea coasts. This last system, Mr. Norman Bazalgette treats as a self-evident proposition; he asserts in opposition to the evidence given by impartial observers, that no silting-up has occurred in the Thames near the Metropolitan outfalls, and considers it a logical inference, that in the absence of disturbing causes, no deposit can take place where the velocity of the current into which the sewage is discharged is greater than the velocity of flow in the sewers; and as might be expected from a barrister pleading a cause, he omits entirely from his arguments the effects of slack-water in a tidal river, and forgets that there is a flood as well as an ebb-tide, which will bring back the sewage taken down by the ebb. The long discussion which followed can have hardly realised the hope expressed in the paper, that a more unanimous opinion on the subject might be promoted by the conclusions with which the paper terminates.

The proper disposal of sewage is a very difficult problem, but we do not despair of some solution being eventually found. Sewage has an agricultural value, but except by irrigation, no perfectly satisfactory method has as yet been discovered of applying it to the land. Many chemical processes have been tried with only partial success. The earth closet system is only applicable to small towns on account of the cost of carriage. Land for sewage farms is expensive in the neighbourhood of towns, and the limited area of land on which the sewage is deposited, causes the amount used to exceed what is desirable. Outfalls into tidal rivers are objectionable, especially where the river near or below the outfall has towns or villages on its banks; as the sewage travels very slowly to the sea, the river is always largely contaminated with it, and even if no palpable deposit occurs, the bed of the river becomes gradually impregnated with sewage. It does not seem probable that a process will be discovered for rendering sewage a valuable product commercially; but we trust it is not beyond the resources of science to devise some means by which our tidal rivers may be freed from pollution, and sewage applied to land at a less cost than that required for throwing it into the sea.

Two short papers on Canadian narrow-gauge railways, and on the emission of heat by hot-water pipes, are printed in the volume, which also contains, as usual, several abstracts of articles from foreign periodicals.

TRANSACTIONS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS, November, 1877.—There is an article on the "Nomenclature of Building Stones and of Stone Masonry," in this number of the Transactions, written with the object of obtaining a more uniform nomenclature for dressed stone and masonry; and to render the subject more complete, a description is also given of the various tools used by the stonemason. The article is fully illustrated by plates, showing both the tools employed and the various dressings of stone, and the different classes of masonry. The rest of the pamphlet is filled with an account of the proceedings at the annual meeting of the society.

INDIAN IRRIGATION WORKS.—A great deal of misunderstanding at present exists, even amongst the otherwise well informed, in this country, regarding the remunerative character of irrigation works in India. Sir Arthur Cotton admits himself to be a man with one idea, but really he has two ideas; one, that irrigation works in India are immensely profitable and ought to be enormously extended; and the other that India ought to and could, be traversed in its length and breadth by lines of water communication; irrigation channels being also made adapted for purposes of navigation. In his views generally, Sir Arthur Cotton has some few supporters who ought to know something of the subject, and doubtless a great many more who accept his statements and figures, but who, of themselves, know nothing about it. About three years ago a book was published, by an anonymous author, entitled "The Indian Problem Solved—Undeveloped wealth in India and State reproductive works. The ways to prevent Famines, and advance the material progress of India." This publication consists of a compilation of extracts from reports, letters, and official documents, bearing generally on the subject of irrigation works, apparently carefully selected with the view of advancing what is in some quarters known as the Cottonian theory; which theory, we are prepared to show, is capable of having a very different light thrown upon it when viewed from the other side of the question. It matters little how many supporters of his views Sir Arthur Cotton may find, or how many books are published for the purpose of expounding his theories; but when the subject is publicly taken up by a person of Mr. John Bright's position, and Sir Arthur Cotton's figures and estimates are accepted by him in their entirety, it is quite time that the question should be publicly taken up and discussed with the view of ascertaining how far the strictures passed on the Indian Government by Mr. Bright are justified by facts, or whether Sir Arthur Cotton is not a little too sanguine in his views.

The one work instanced as a proof of the extremely remunerative character of irrigation in India is the Cauvery delta system of canals, which has yielded a return of over 85 per cent., upon a capital outlay of a little over £133,000. This, it must be admitted, is but a small expenditure from which to estimate the probable returns from a further proposed outlay of between 25 and 30 millions on similar works. Besides this, a little further examination into the circumstances of this exceptionally remunerative work, may perhaps tend to throw such a light on the subject as to alter the whole question. In the first report of the Madras Public Works Commissioners, there is given an extract from a report, dated August 12, 1844, by Sir (then

Captain) A. T. Cotton, wherein it is stated, with regard to the district of Tanjore, "When we got possession of that district it was in a far more advanced state than Rajahmundry is now; there was already something like a system of irrigation, and especially one main work, the grand anicut, built to prevent the Cauvery rejoining the Colleroon; so that the district, or at least those parts of it that were irrigated, were not dependent merely upon the high freshes of the river, but received a supply of water almost as long as there was any in the Cauvery." This ancient native work was a solid mass of rough stone 1080 feet long and 40 feet broad, stretching across the bed of the Cauvery, and is supposed to have been built upwards of 1600 years ago, according to the "Moral and Material Progress Report" on India for the year 1871-72, page 58. Captain Cotton's Report goes on to say, "soon after the assumption of the country, the grand anicut was raised; by degrees innumerable small works, such as sluices, &c., and new channels, were executed; the river banks were extended and strengthened; and at last two new anicuts were constructed on the Colleroon to prevent the escape of any water to the sea." In 1836, before the construction of any of these additional works by the British, the Cauvery and Colleroon supplied irrigation to 630,613 acres; in 1850, it was 716,524 acres, and now it is over 800,000 acres, or about half as much again as it was before any of the above mentioned sum of £133,000 was laid out upon the works. In order then to ascertain what return is actually obtained from that expenditure, it will be necessary to examine the matter a little more in detail. In the Godavery delta, irrigation existed before the present works were constructed, but no anicut had been built as in the case of the Cauvery. The cost of the present irrigation works in that delta has amounted to about Rs. 13 per acre irrigated. In the Kistua delta, irrigation channels were also in existence before the construction of the existing works, and they have cost Rs. 19 per acre, whilst we are asked to believe that the Cauvery works have cost only Rs. 1½ per acre of land irrigated. If, allowing for the ancient native works on the Cauvery, the cost of the works as they now stand be taken at Rs. 15 per acre irrigated, the capital expenditure will amount to Rs. 1,25,28,120, or between nine and ten times the amount with which they are credited, a sum far more likely to represent the true value of the works than the bare amount spent on them by the British Government, and the per centage of net revenue will then be reduced from 85 to about 9½ per cent., a result in itself satisfactory, and probably not far from the real truth. We must defer a consideration of the other issues raised by Sir Arthur Cotton for a future occasion.

DETECTION OF TRACES OF COPPER.—M. L. Cresti (*Gazzetta Chimica Italiana* vii., 220-222). On immersing a small couple formed of zinc and platinum wires in a solution containing even a mere trace of copper, the copper is deposited on the platinum wire, and if it be exposed to the vapour of hydrobromic acid, it is converted into copper bromide. If, however, the platinum wire coated with copper be exposed while still moist to the vapour of bromine and then to the vapour of hydrobromic acid, or *vice versâ*, an intense violet coloration, even with a very minute quantity of copper, is produced. The best plan is to expose the moist coating of copper to the mixed vapours of bromine and hydrobromic acid given off in treating potassium bromide with concentrated sulphuric acid. The tint may be seen with advantage by touching a white porcelain plate with the point of the moist platinum wire after exposure; after the experiment, the wire may be inserted into the flame of a Bunsen burner to show the green copper flame. M. Cresti considers the blue coloration to be due to a combination of hydrated copper bromide with hydrobromic acid.

ESTIMATION OF ZINC AND LEAD IN MINERALS BY ELECTROLYSIS.—MM. G. Parodi and A. Mascazzini (*Gazzetta Chimica Italiana* vii., 222-224) find that zinc can be precipitated on platinum in a coherent film, which can be washed and weighed, if the solution be first rendered ammoniacal and then acidulated with an organic acid, preferably acetic, and submitted to electrolysis, care being taken to adjust the current to the strength of the solution. The iron, lead, &c., present in calamine, blende, and other zinc minerals, should be removed by Schwartz's method before electrolysis. The presence of a trace of lead increases the coherence of the film, if no mineral acid but sulphuric be present. Lead may be precipated in a coherent state by acting on alkaline solutions containing phosphoric and tartaric acids. The presence of acetic acid tends to keep the positive pole free from lead peroxide.

THE FOSSIL BEDS OF OREGON.—These remarkable fossil deposits are situated near Fossil Lake, twenty-six miles north-east of Silver Lake, in Lake County, Oregon. They might have remained for a long time undiscovered but for the action of the wind which has laid them bare. There appears to be a constant wind from the south-west in that district, which has scooped out the surface sand and piled it up at a distance in mounds of every conceivable form and beautifully stratified. In the bottom of the hollow thus excavated have been found fossil bones of the elephant, camel, horse, elk or reindeer, those of the horse being by far the most abundant. Bones of smaller quadrupeds were also found: for example, the fox, wolf, and goat. Many remains of birds, waders, swimmers, scratchers, and probably climbers, were recognised, as also the vertebræ of fishes. The fossils thus revealed lie scattered on the ground in a north-east and south-west direction, over an area four or five miles long by a mile wide. Near the south-west end of the deposit are two small lakes or ponds, highly impregnated with alkali. Further exploration of this interesting locality may bring to light

many vestiges of past life of great importance to the paleontologist.

COLDNESS OF LEAVES.—In a recent memoir to the Academy of Sciences, Paris, on the functions of leaves, M. Joseph Boussingault attributes the fresh feeling of living leaves even in the sunshine to the evaporation of the sap of the plant from their surface. When a leaf is detached from its parent stem the sap is cut off, and the feel of the leaf is the opposite of fresh.

SOLAR PHOTOGRAPHS.—Solar photographs are a valuable supplement to telescopic observations, and since they admit of direct comparison from time to time, it is possible by means of them to discover varying phenomena which the telescope alone might never reveal. It has been recently found by M. Janssen, from photographs taken at the observatory of Mendon, that the granulations on the solar disc, known as "rice grains," have a very variable luminosity depending on their depth within the gaseous masses which surround them.

"LOUPES."—This article of trade is much sought after in the mountains separating the Caspian provinces from Irak, or Persia proper. As is well known, *loupe* is the French term for the great burrs, wens, or excrescences on trees, from which the handsome veneers are cut for inlaying fancy furniture. Walnut, maple, wainscot oak, and other cabinet wood yield these finely marked curled excrescences. It is only produced in the highlands, where it may be purchased at a very low rate; but, owing to the labour attending its transport in a country destitute of means of communication, it costs too much for speculative purposes to bring it down to the ports of shipment. Some good specimens of this valuable excrescence were, notwithstanding, brought down last season. The best marked samples of this wood are sent to England, *via* Tiflis, while the ordinary qualities suit best the French market. Some loupes are to be found weighing upwards of a ton; but, owing to the means of transport, they have to be reduced in size. . . The loupe is introduced into a large receptacle, and steamed for several days consecutively, until, from the adamantine hardness it naturally possesses, it assumes the consistency of cheese. It is then placed under a machine, which, with a large blade, slices it off into sheets, which harden by exposure, and are sold in the market according to size and beauty of design; some loupes, in Paris, have fetched as much as £800 sterling.—*Consul Churchill's Report.*

GEOLOGICAL TIME.—At a recent meeting of the Royal Society, the Rev. Samuel Haughton read a paper on the limits of geological time. Mr. Haughton has already given good reasons for his opinion that the elevation of the continents of Asia and Europe displaced the axis of *maximum inertia* one degree from its former position. The axis of rotation of the earth, thus displaced through sixty-nine miles from the axis of the figure, began to revolve round it. But for the friction of the ocean on its bed this displacement of the axis of rotation from the axis of figure would continue for ever. The ocean, however, tends to keep revolving round the axis of yesterday while the solid earth is of course revolving round the axis of to-day. In this way friction of the ocean on its bed takes place, the ocean acting as a liquid friction brake, and this tends to bring the axis of rotation back to coincidence with the axis of figure. Mr. Haughton's calculation brings out the result that 641,000 years would be required to restore the coincidence of the axis, and, therefore, the formation of the continents of Asia and Europe cannot be more recent. Further calculations assigned the lower limit of geological time as eleven million years in round numbers.

NATURE'S HYGIENE.—There is good reason for believing that the presence of trees in certain miasmatic localities have the effect of rendering the air healthful. It is not yet a settled point whether the beneficial influence is confined to certain trees or is common to all, and whether it is an effect of certain secretions of the tree, or due merely to its screening action on the malaria. In support of the latter view two cases from India have been cited, namely one in which a station which was screened from a large swamp by a grove of mango trees, becoming very unhealthy when the trees were cut down, and recovered its healthiness on their being replanted; and one in which an unhealthy station, near a marsh, became healthy when a forest of babool trees were intervened between it and the swamp. The Trappist Monastery at Tre Fontane, near Rome, was until recently so fatal that one by one the monks sent to it succumbed to fever. With praiseworthy perseverance the monks have planted a vineyard, and many eucalyptus trees round it, and now the place is much healthier, and the monks attribute the change to the eucalyptus. It is generally believed that the atmosphere of pine forests is favourable to invalids suffering from pulmonary disease, and it has been supposed that the oxydation of the oil of turpentine exuded from pine trees, and of other essential oils such as the odorous oils of flowers in the air is attended by the formation of ozone, because the oxydized oils and the air in their vicinity exhibit the reaction of ozone with potassium iodide and starch. It has been well proved that the air of the country contains an oxydising and odorous substance called ozone, capable of bluing iodized red litmus paper, of decolorising blue litmus paper without previously turning it red, and of destroying bad smells. It is supposed by some that ozone is in great abundance in eucalyptus forests, and hence the reputed sanitary effect these trees have; others attribute their power to the rapid absorption of the marsh waters. Recent experiments of Mr. Thomas Taylor on the preservative

properties of eucalypti demonstrate the fact that oxydation of the gases of malarial districts, and consequently their improved health conditions in the presence of the essential oils of the eucalyptus family, or of other odoriferous plants, are not necessarily the result of ozone. Any acid or substance having an acid reaction will oxydise the potassium of iodide of potassium (the usual test for ozone); eucalyptol, turpentine, benzol, or any of the essential oils will oxydise potassium when it is combined with sulphur or iodine, hence the purification of the atmosphere may be to some extent effected without having recourse to the theory of ozone. Mr. Taylor also finds that skins of animals may be preserved by rubbing the fleshy side with eucalyptus oil. If combined with plaster and injected into the veins and arteries of animals it will preserve the flesh from decay. Beef or other animal matter can be preserved in a fresh state by it. The result of his experiments are that nearly all essential oils, and especially eucalyptus oil and turpentine, possess an oxydising property, with the power to decompose certain products deleterious to health, which are always present in malarial regions, and result from animal and vegetable decay.

MANGANESE BRONZE.—This new alloy, which is composed of fifteen parts copper, four parts magnanese, and one part zinc, exceeds in tensile strength both Muntz metal and gun-metal. At the Woolwich Arsenal recently a cold rolled bar one square inch in sectional area, sustained a load of forty tons before breaking. The weakest kind is half as strong again as Muntz metal, and at the same time sufficiently ductile to be rivetted cold. It can be converted into thin sheets, plates, tubes and wires, and is much superior to brass for such a purpose, being twice as hard and twice as strong. It is particularly well suited for boiler and condenser tubes of engines, since the highest temperature it can be subjected to in a locomotive or other high pressure engine does not appear to reduce its hardness, toughness, and rigidity in the least.

PHOSPHOR BRONZE.—It has until lately been believed that tools of copper or gun-metal were incapable of giving out sparks of fire in working, and it has been hitherto the custom to use them in connection with explosive materials; but it has been recently proved that friction produces sparks from both of these metals, and it has therefore been ordered that in future all implements employed in the manufacture and manipulation of gunpowder for the Government shall be made of phosphor-bronze, which is the least liable to strike fire of all known metals suitable for the purpose.

EFFECT OF GAS LIGHTING ON LEATHER.—Professor A. H. Church points out that the well-known disintegrating effect of the products of gaslight in rooms on the leather binding of books, is probably due in the main to sulphur. It appears that vellum is not affected by the fumes, morocco very slightly, calf considerably, and Russia most of all. The injurious effect is always most marked on the upper shelves of a library, whither the heated products of combustion ascend, and are absorbed by the leather. In newly bound books, the quantity of sulphur in the leather is found to be small, and due to traces of sulphates in the size and dye; there is no free sulphuric acid to be found. But in the case of old library books, in which the leather has become dry and friable, as much as eight per cent. of sulphuric acid has been found, six per cent. being in a free state.

FOREST TREES OF CHILI.—Some time ago it was stated by the Liverpool Chamber of Commerce that the supply of material for tanning leather was falling off in England. Mr. T. Plelsey, a Peruvian gentleman, therefore draws attention to *luigue*, a tree of Chili, a species of oak whose bark is used for tanning leather. It is found in the extensive forests of the province of Baldivia, where there are other large and handsome trees, such as the *loroutilla* and the *ulma*, which, like the *auracaria* or Chili pine, would be a beautifying acquisition to English parks and gardens.

THE COQUITO PALM.—In Chili a sweet syrup, called *miel de palm*, or palm honey, is prepared by boiling the sap of the *jubœa spectabilis* to the consistence of treacle, and it forms a considerable article of trade, being much esteemed for domestic use as sugar. The sap is obtained by the very wasteful method of felling the trees, and cutting off the crown of leaves, when it immediately begins to flow, and continues to do so for several months until the tree is exhausted, provided that a thin slice is shaved off the top every morning. Each tree yields about 90 gallons of juice. The small nuts, which resemble miniature cocoanuts, are used by the Chilian confectioners in the preparation of sweetmeats, and by boys as marbles.—*Journal (American) of Applied Science.*

FOSSIL FERNS IN SILURIAN ROCKS.—It has hitherto been considered by geologists, that the Silurian rocks of Europe contain no remains of plant life except *algæ*, but fossil ferns have recently been discovered by M. G. de Saporta, in the Silurian system of Angers, in France. The specimen was found in a slab of schistose rock from the Middle Silurian strata, and though somewhat imperfect, was tolerably well preserved. The vegetable matter had been replaced by iron pyrites. The veining of the frond shows that the ferns resemble some of those peculiar to the Upper Devonian and Lower Carboniferous period. Although this is the first evidence of so high an order of vegetable life in the European Silurians, fern remains have before been discovered in some of the American Silurians. As ferns are highly organised plants, it is probable that others less complex in structure may yet be found in those rocks.

METEORITES.—It is estimated by Professor Newcome of America, that four hundred million shooting stars are fused daily in the earth's atmosphere. The resulting *débris* slowly settles to the ground, and must produce an increase of the earth's mass. According to Professor Harkness, of the American Naval Observatory, the average weight of each meteorite does not exceed a grain. Those visible only by means of the telescope are probably no larger than sand grains, and those which are seen over a radius of 150 miles, and fill several cubic miles of air with the smoke of their dissolution, are probably several ounces, perhaps pounds, in weight. Taking each meteor to weigh ten grains instead of one, the four hundred millions which reach the earth daily would amount to 290 tons of matter added each day to the earth's mass, or 106,000 tons yearly. This quantity, if distributed equally over the earth's surface, would form in four million years a stratum about the thickness of ordinary paper.

METEORIC IRON.—Some large polished plates of meteoric iron sawn out of the metoric masses which have been found in the province of Santa Catharina, Brazil, were recently on view at the Academy of Sciences, Paris, and presented a remarkable mosaic structure made up of angular fragments of metallic iron, bound together by a cement composed of pyrhotène, graphite, and magnetic oxide of iron. M. Daubrée has reproduced the cement by heating an iron wire to redness and exposing it to the action of the vapour of sulphuret of carbon.

ELECTROSTRICTION. — Professor Young has found that when a thermometer bulb is coated with silver by chemical means, and then electrotyped over with the same metal, the mercury rises in the tube to a definite position on the scale independently of temperature. Copper, silver, iron, and nickel in this way "constrict" the bulb, whereas zinc and cadmium distend it.

KNOWN PLANTS.—The total number of known species of plants at the present time has been estimated at 90,000 dicotyledons, 20,000 monocotyledons, and 40,000 cryptogams,—about 150,000 species divided into 8,000 genera. It is highly probable that this number will, at least, have been doubled, when the whole surface of the earth has been explored.

NEW MATERIAL FOR PAPER.—For many years a cheap substitute for rags in the manufacture of paper has been diligently sought. Straw, rushes, esparto grass, woody fibre, &c., have been tried in town, but it has been necessary to supplement them by an admixture of rag, in order to produce the finer qualities of paper. A new and likelier material is said to have been discovered in the pith of the *Yucca Draconis*, a giant cactus of the Mohave Desert in Arizona, where it flourishes in thick brakes, resembling forests.

USES OF CROOKE'S RADIOMETER.—As velocity of its rotation depends upon the intensity of the light, it is a reliable instrument to measure the value of illuminating gas, and compare it with any adopted standard. When, for instance, it has been found that a certain instrument makes twenty revolutions per minute when exposed to the light of a standard candle, at the distance of say six inches, a gas flame which excites twice or four times this velocity, will be a two or four candle light; or it may be placed at such a distance as to sustain the same velocity of rotation, when the squares of the comparative distances will give the comparative intensities.

The instrument demonstrates directly the law that the intensity of light decreases as the inverse ratio of the squares of the distances. For instance, if a candle placed at a distance of six inches causes forty revolutions per minute, at three inches, or half the distance it will give 4×30 or 120 revolutions; at twelve inches or double the distance it will give $\frac{1}{4} \times 40$ or ten revolutions per minute, and so on. It may, therefore, be used before a class of physics, to demonstrate an important law in optics of extensive application in astronomy, as well as in the art of determining the value of various kinds of artificial flames used for illumination.

The instrument may be used by photographers. Placing it near the sitter, the operator may observe how many revolutions it takes to make a good picture; and then he may for the future count, not the number of seconds, making it more or less in proportion as he guesses the light to be stronger or weaker than usual, but simply count the number of revolutions of the instrument. If once, say with twenty revolutions per minute, he made a good picture, he may be pretty certain that, if the light is only half as strong and requires double the time of sitting, the instrument will occupy twice as much time to make the twenty revolutions; and, when, inversely the light is say one-fourth stronger requiring one-fourth less time of sitting, the instrument will go just so much faster, and make the twenty revolutions in exactly so much less time.—*Manufacturer and Builder.*

City Notes.

Old Broad Street, Feb. 14, 1878.

THE meeting of the proprietors of the Anglo-American Telegraph Company appears to have been free from unpleasantness. Viscount Monck, who was in the chair, made a statement, and moved the reception and adoption of the report. The report was adopted and received by a unanimous vote, and the proceedings terminated in the usual manner. We have already announced that the dividend declared was 1½ per cent., making 4 per cent. for the year. The total receipts of the company from July 1 to December 31, including a

balance of £1,506 carried over from the last account, amounted to £283,319, while the total expenditure of the half-year, including income tax and the ordinary repair of cables, was £42,591. But there is a huge item, not charged to the half-year's expenditure, of £86,960 for a "special repairing expedition." This amount is debited to the renewal fund, a course which, at any rate, invites criticism. The directors have shown some courage in resolving to increase by £50,000 the sum laid by every year until, as the chairman appropriately observed, the reserve fund is more secure. But it appears to us that though this is a move in the right direction, it is not enough. A company with a capital of seven millions ought to have a very large reserve fund; that of the Anglo Company is, at present, altogether inadequate. In a single year nearly £100,000 of it had been swept away, and who can venture to assert that a corresponding sum may not be needed any other year? If the directors are wise they will next half-year propose that £250,000 per year be put aside towards reserve. Let a good dividend be paid, by all means, if possible, but not at the risk of reducing the reserve fund. When will directors see that no company can be really strong which does not, happen what may, keep up an adequate reserve? Perhaps the directors think that as the company has practically only three cables the addition to the reserve is sufficient.

There is one point in the speech of the chairman of the Anglo-American Company which we note with special pleasure, because it shows that the *Telegraphic Journal* has not advocated the claims of engineers in vain. Lord Monck, referring to the working expenses of the company, confessed that they had been reduced to the lowest point compatible with efficiency, and the shareholders might have rather to look to some increase of expense in connection with the salaries of their officers. We have always sought to protect—and shall always seek to protect—the interests of the public and the interests of the shareholders as against the interests of company promoters and speculators. But we shall also never cease to assert that the interests of the public and of the shareholders are best maintained by the employment of well-paid and, therefore, probably able officers. The directors of the Anglo Company, and the observation applies to other companies, will do well to increase the salaries of their officials without delay. It is certain that the companies which are liberal in their treatment to their employés, will continue to command the services of the most capable men—and capable officials help to make, as incapable ones may help to mar, the fortunes of a company.

Does not the *Daily Telegraph* know the difference between the Submarine Telegraph Company and the Cuba Telegraph Company? Yet we learn from our contemporary that the directors of the Submarine Company have declared a dividend of 8 per cent. on the ordinary shares, that they have carried forward a sum of £227 16s. 6d., that they have placed £2,500 to the reserve fund—in fact, the figures are identical with the figures in the report of the Cuba Company. If the City editor of the *Daily Telegraph* will refer to the report of the Submarine Company he will learn that that company will pay a dividend of 17 per cent. per annum, and that the receipts for the half-year show a decrease of £2,465 compared with the corresponding period last year.

The directors of the Submarine Telegraph Company do not seem to think that they have any reason to grumble at the decrease in their receipts; in fact "considering the political state of Europe, and the extraordinary depression in trade," it appears to them to be "a matter of congratulation" that the company has not done worse. We cannot quite agree with the directors of the Submarine Company; we should have thought that very fact of the excitement in Europe would have been the means of increasing the revenue of the company. It has been so in other cases. The dividend is, of course, a good one. We shall note the proceedings at the meeting—which is being held as we go to press—with interest. The cost of renewing the land line erected in 1859 between Cape Grisnez and Boulogne, in connection with the Boulogne Cable, has very properly been charged against the revenue of the half-year.

The directors of the Cuba Submarine Telegraph Company have declared a dividend of 8 per cent., leaving £228 to be carried forward. We learn from the report that the gross receipts for the half-year, including the the balance brought from last account, amount to £16,466 9s. 8d., and the expenses to £4,338 13s. 2d., which is highly satisfactory. But the directors of the Cuba Company have made one little mistake: the amount they have placed to the credit of the reserve fund is too small. It would have been far better policy to have added to the £2,500, and been content to pay a smaller dividend. There really seems to be something like a mania for neglecting Reserve Funds. The smaller companies have caught the malady from the large ones. It is to be hoped that both large companies and small ones will soon see the folly of a policy which is incapable of justification. A hundred pounds seems a large sum for a company like the "Cuba" to spend in six months on "law charges." But we presume the charges were involved in the proceedings instituted by the company against the Spanish Government in the matter of the tax levied on their local business in Madrid. We cordially hope that the decision will be favourable to the company.

Those who predict that another year will witness an extension of telegraph business must bear in mind that the traffic returns of most of the telegraph companies have been exceptionally high the last twelve months. No doubt if the Eastern Question is not disposed of shortly—above all, if there be a development of the war, the returns will not diminish in 1878; but the moment there is peace, telegraphic messages will decrease in numbers and in length. Of course it may be urged that the traffic receipts of the Anglo-American and Direct Companies were below the mark last year; and that, we admit, was so. But all things considered, 1877 may be said to have been a prosperous year for the principal telegraphic companies.

It is announced that the Telegraph Construction and Maintenance Company will, subject to the audit of accounts, pay a dividend of 15 per cent. (£1 16s. per share) in addition to the *ad interim* dividend of 5 per cent. already paid, making 20 per cent. for the past year. That this company—which, by the way, is said to have executed contracts to the total amount of one million sterling during 1877—is admirably managed, must, at least, be granted.

The half-yearly report of the Metropolitan District Railway Company is encouraging. In 1872 the company did not pay any dividend; in 1873 only half per cent.; 1874 one and a half; 1875 two and three quarters; and in 1876 three and a half per cent. But in 1877 the company made sufficient progress to enable the directors to pay four and three quarters per cent. It is very satisfactory to learn from the report, and also at the meeting of shareholders, that the Metropolitan Company have distinctly recognised the principle that the completion of the Inner Circle scheme should be effected at the joint cost of the two companies, because it thus becomes a matter of more than surmise that the Inner Circle will really be completed some day. We shall be glad to see the Circle commenced.